



REUSE OF TREATED MUNICIPAL WASTEWATER IN MARYLAND

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Introduction

- **MDE promotes water reuse and recycling.**
- **Maryland experienced a drought in 2002 resulting in many drinking water wells going dry.**
- **Reuse of treated wastewater through irrigation replenishes the groundwater resource**
- **Microbiological and chemical impacts limit irrigation of treated wastewater on land.**
- **Governmental agencies establish guidelines to regulate water reuse projects.**



Introduction

(continued)

Water Reuse Guidelines –

1. World Health Organization (WHO) –

“Guidelines for the Safe Use of Wastewater and Excreta in Agriculture and Aquaculture – Measures for Public Health Protection (1989)

2. US EPA –

“ Guidelines for Water Reuse” (1992, revised in 2004)

3. Maryland Department of the Environment (MDE)-

“ MDE Guidelines for Land Treatment of Municipal Wastewaters” (1973, revised in 1987 and 2003)



Major Category of Water Reuse -Agricultural Irrigation

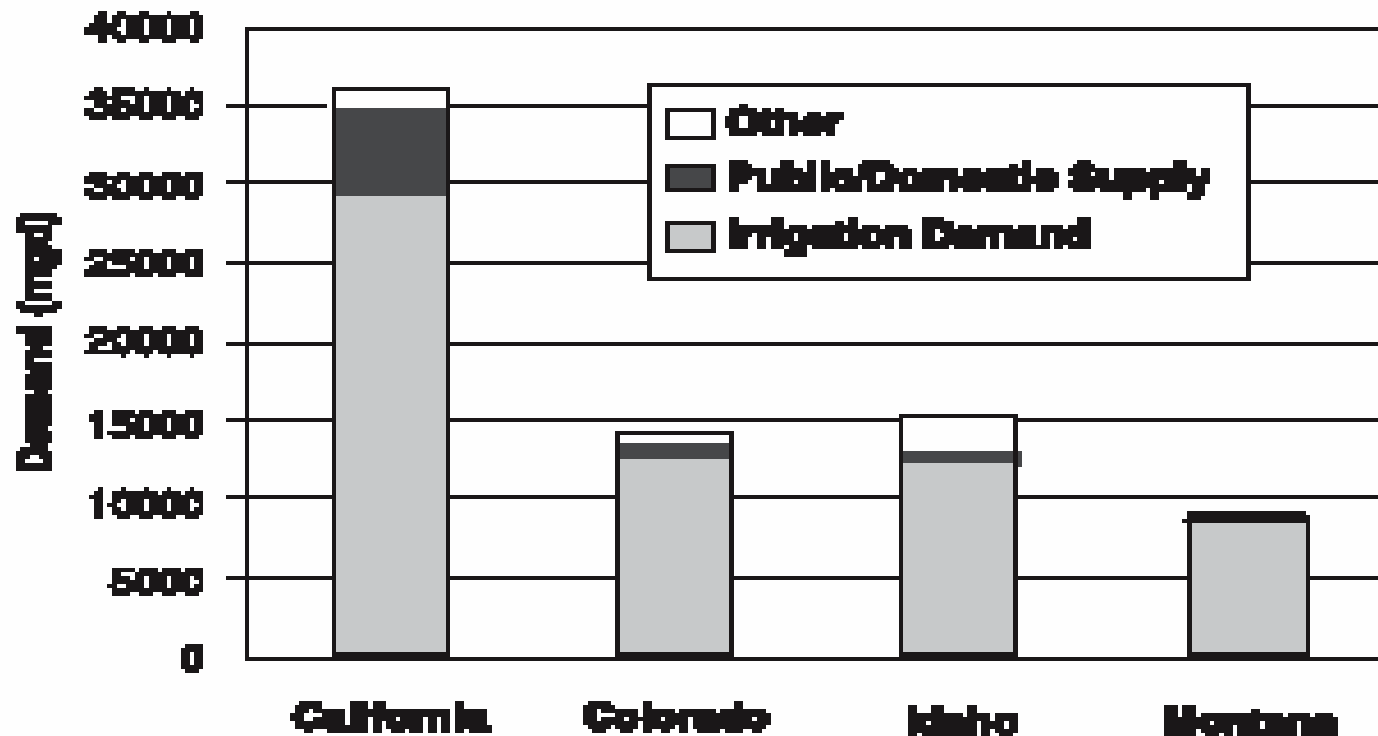
IN USA, significant amount of reclaimed water is used for agricultural irrigation (48% of California reclaimed water is for agricultural irrigation*).

The reasons for this trend are:

- **Extremely high water demands for agricultural activities;**
- **Significant water conservation benefits with agricultural reuse; and**
- **Easy to integrate**



Comparison of Irrigation Demands in Four States of USA (1995)



Source: US EPA 2004 Guidelines for Water Reuse



Reclaimed Water Quality for Agricultural Irrigation

Water quality for agricultural irrigation must consider the following:

- 1. Soil Properties (effects of sodium and metals);**
- 2. Crops (effects of specific ion toxicity);**
- 3. Groundwater (MCLs) and Surface Water Quality (N&P); and**
- 4. Public Health (aerosols and well drinking water quality)**



Maryland Water Reuse (Background)

- 1. Majority of projects in Maryland are spray irrigation systems installed for agricultural crops.**
- 2. The largest spray irrigation system permitted in Maryland is for 0.75 million gal /day.**
- 3. Capacity of systems is limited by the availability of land and suitability of soil and groundwater conditions.**



Spray Irrigation Systems for Municipal Wastewaters in Maryland

- 32 existing spray irrigation systems in Maryland. $4 \geq 0.5$ mgd
- COMAR 26.08.02.09 State Groundwater Discharge Permit required.
- Soils and groundwater table depths are specified in the Maryland Department of the Environment Guidelines for Land Treatment of Municipal Wastewaters.
- Class I or Class II effluent quality required for irrigation. Two tiers of buffer zone requirements are applicable depending on effluent qualities.
- Groundwater quality monitoring is required in the discharge permit. Water quality at monitoring wells may not violate drinking water standards.



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Buffer Zone Requirements

- **Class I effluent**

Minimum of 200 feet from the wetted perimeter to property lines, waterways and public roads in open areas. Minimum of 500 feet from the wetted perimeter to houses or other occupied structures. 50% reduction in distance with tree buffers.

- **Class II effluent**

Minimum of 25 feet from the wetted perimeter to property lines, housing structures, waterways and public roads. Minimum of 50 feet to schools and playgrounds. Minimum of 100 feet to potable wells and water intakes



Application Rates for Spray Irrigation Systems

- Determined according to the lower value of the infiltration capacity of the soil or the nitrogen uptake rate of the crop to be planted on the spray field.
- Soil infiltration rate is determined by infiltrometer tests. Nitrogen application rate is determined by the nitrogen mass balance equation included in the State Guidelines.
- Irrigating 1 mgd wastewater flow at 1"/wk requires approximately 250 acres irrigation area (excluding buffer zone)



Results of Nitrogen Balance for Various Irrigation Conditions

Irrigation rate (inch/wk)	Type of Crop	Nitrogen uptake rate (lb/acre/yr)	Effluent nitrogen Con (mg/l)	Percolate nitrogen (mg/l)
2"	Corn	180	7.6	0
2"	Reed Canarygrass	349	14.8	0
2"	Corn	180	11.6	4
2"	Reed Canarygrass	349	18.8	4
1"	Corn	180	15.2	0
1"	Reed Canarygrass	349	29.6	0



Results of Nitrogen Balance for Various Irrigation Conditions

Irrigation rate (inch/wk)	Type of Crop	Nitrogen uptake rate (lb/acre/yr)	Effluent nitrogen Con (mg/l)	Percolate nitrogen (mg/l)
2"	Forest with Mixed hardwoods	195	8.3	0
2"	Soybeans	223	9.5	0
2"	Forest with Mixed hardwoods	195	12.3	4
2"	Soybeans	223	13.5	4
1"	Forest with Mixed hardwoods	195	16.6	0
1"	Soybeans	223	19	0



Prince Frederick Spray Irrigation System

(Maryland Case Study operation in 2002)

Prince Frederick Spray Irrigation System

- Design flow: 300,000 gal/day (1,130 m³/day)
- Hydraulic loading rate: 1.7"/wk (4.3 cm/wk)
- Pre-treatment system : Sequential Batch Reactor (SBR)
- Spray Irrigation site: 55 acres initial area, 13 acres reserve
- Storage capacity: 60 days

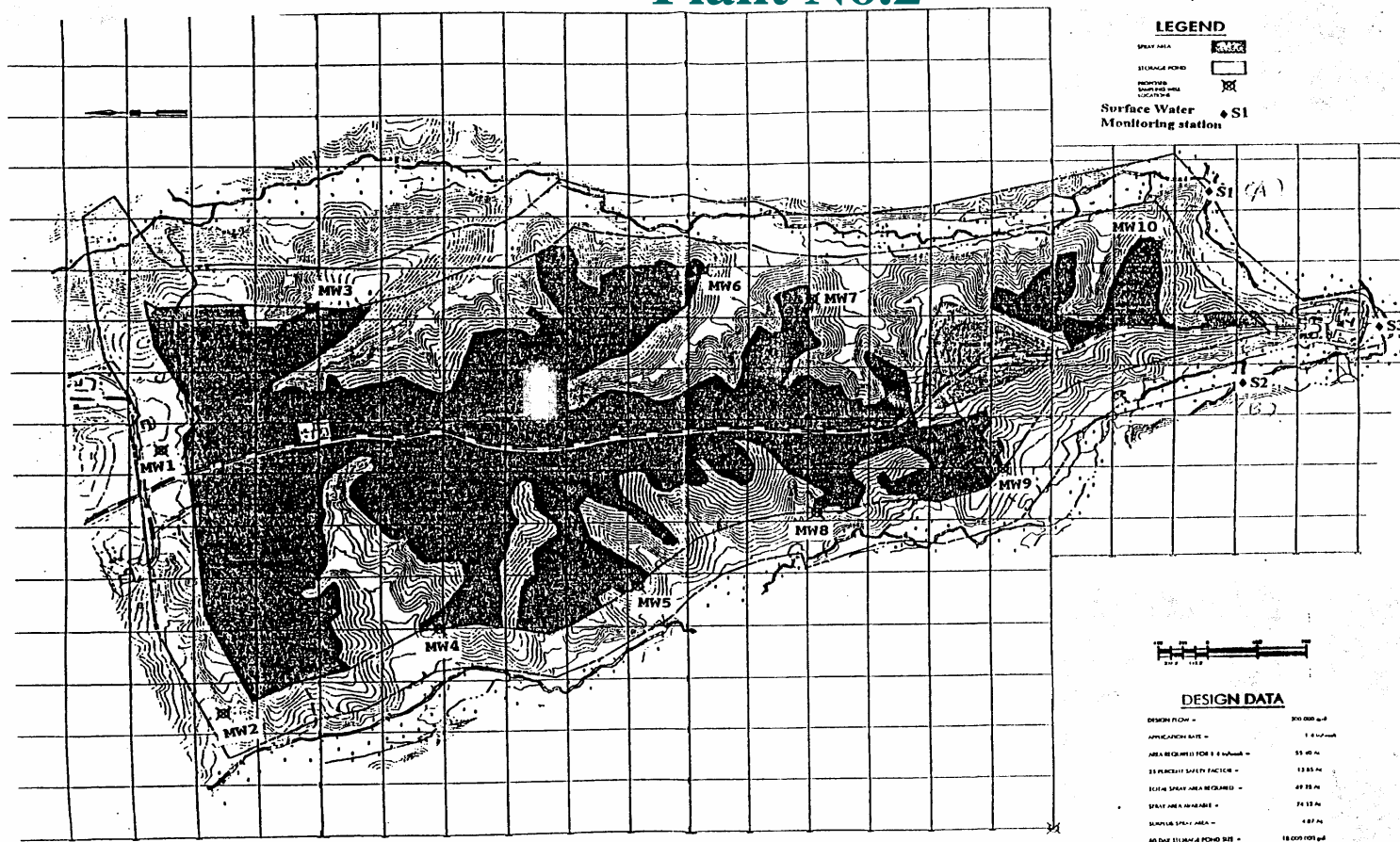


Prince Frederick Water Quality Limitations

- **Effluent quality:** BOD < 70 mg/l, TSS < 90 mg/l and Fecal coliform < 200 MPN/100 ml
- **Monitoring at** 10 monitoring wells and three surface water stations
- **Sampling Frequency:** Every 3- month for 7 parameters
- **Groundwater Quality** at down gradient wells shall meet MCLs except for nitrogen (limited at 5 mg/l at wells for protecting surface water quality at Parker's Creek)



Layout of Spray Irrigation Field and Locations of Groundwater Monitoring Wells (MW1-MW10) at the Prince Frederick Wastewater Treatment Plant No.2





Prince Frederick No2 WWTP, SBR- Aeration (300,000 gal/day)





Prince Frederick No.2 WWTP, SBR – Settling





Price Frederick No.2 WWTP Chlorination Tank





Prince Frederick No.2 WWTP, Storage Pond (60 day)





Prince Frederick No.2 WWTP, Spray Irrigation Field (55 acres)





***Most Recent Effluent Quality
(Prince Frederick No.2 WWTP)***

Parameters	BOD (mg/l)	SS (mg/l)	Fecal Coli (mpn /100 ml)	TKN (mg/l)	NO₃ (mg/l)
4th Quarter 2006	3.9	7.8	<2	3.7	0.78
1st Quarter 2007	3	10.6	<1.8	3.0	1.1



Most Recent Monitoring Well Groundwater Quality (Prince Frederick No.2 WWTP)

Average concentration of 10 wells

Parameters	PO ₄ (mg/l)	pH (unit)	Fecal Coli (mpn /100 ml)	TKN (mg/l)	NO ₃ (mg/l)	TDS (mg/l)	Cl ⁻ (mg/l)
4th Quarter 2006	0.25	5.5	10 (two samples with 70 MPN in Nov.)	0.28	0.18	200	53
1 st Quarter 2007	0.36	5.4	<1.8	0.12	0.23	167	52.7